

Reference 34

Omondi, MO; Xia, X; Nahayo, A; Liu, XY; Korai, PK; Pan, GX 2016 Quantification of biochar effects on soil hydrological properties using meta-analysis of literature data *Geoderma* 274:28–34. 10.1016/j.geoderma.2016.03.029

Background and objective

The use of biochar as a soil amendment had been increasingly advocated for its effects on carbon sequestration and greenhouse gas emission mitigation as well as on improvement of soil fertility. However, lack of a general assessment of biochar effects on soil physical properties made it difficult for the recommendations for its practical use for soil quality improvement in global agriculture. Draw a general quantification of biochar's effect on improving soil physical properties. The authors aimed to provide recommendations both for future biochar studies and for potential use of biochar in right soils around world.

Search strategy and selection criteria

Literature search of published articles was performed via Web of Science and Chinese magazine net CNCK. While in searching, key words used were of biochar and soil physical properties, and/or hydraulic conductivity, and/or aggregate stability, and/or available water capacity, and/or porosity or bulk density. Only the biochar soil studies that compared the changes between the control (without biochar) and biochar amended soils were collected to form a literature data base. The authors excluded the studies without replicated treatments and data pairs.

Data and analysis

Data treatment and processing were performed with Microsoft Excel 2010. All figures were expressed as the mean response factor and 95% confidence intervals (CIs) for each group. The 95% confidence intervals were obtained by taking the lower and upper limits that were 2 standard deviations from the mean of a particular group. Regression analysis was performed using IBM SPSS (Version 20.0) software, with a significance defined at $p < 0.05$.

Number of papers	Population	Intervention	Comparator	Outcome	Quality score
34	Field, greenhouse pot experiments and laboratory incubations	Soil amendment with biochar	No amendment	Metric: Total soil porosity, soil aggregate stability; Effect size: Logarithm of ratio of the considered metrics in the intervention to the considered metrics in the control	0.625

Results

- Biochar amendment caused a very significantly ($p < 0.01$) increase in total porosity by 8.4% on average.
- Biochar soil amendment significantly ($p < 0.05$) improved aggregate stability by 8.2% on average.

Factors influencing effect sizes

- Biochar application rate : Total porosity increase was seen by 4%, 3.5%, 8.6% and 19% respectively for low, medium, high and very high application rates, being generally proportional to application rates. The increase in low and medium application rates was however not significant.
- Biochar feedstock : Total porosity was increased very significantly ($p < 0.01$) increased (by 11.6%) with crop residue biochar despite of insignificant increase with other feedstock biochars.
- Soil texture : There was a total porosity was very significantly ($p < 0.01$) increased (by 7.5%) in coarse textured soils and significantly ($p < 0.05$) increased (by 7.1%) in fine textured soils.

Conclusion

Biochar amendment could significantly improve soil physical properties, such as porosity and aggregate stability (around 8% grand mean for both metrics).